Modification of the Stratification and Velocity Profile within the Straits and Seas of the Indonesian Archipelago

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LONG-TERM GOALS

To understand the circulation and mixing within the Indonesian Seas associated with topographic configuration, monsoonal driven sea-air flux of momentum and buoyancy, and tides.

OBJECTIVES

1. To utilize existing in situ data (XBT/XCTD, CTD, LADCP, mooring time series, tide gauge records) and satellite data (TRMM, SAR, SST, scatterometer, altimeter) to advance the study of the spatial and temporal scales of topographically and tidally linked circulation, sea-air fluxes, and mixing and internal wave phenomenon within the Indonesian Seas.

2. To develop a program in collaboration with Indonesian marine agencies and universities to study regional variability of meso- and sub-mesoscale processes and ocean strait dynamics within the Indonesian Seas, centered upon field observations.

APPROACH

First to acquire existing in situ and satellite data and to assess the relevant regional scale, meso-scale and smaller processes within the Indonesian Seas, as well as to attend preliminary discussions in Indonesia for the development of a small-scale circulation and mixing program. Second, the data analysis will be refined and published and explicitly used to develop and define the Indonesian program design with Arnold Gordon (Lamont-Doherty Earth Observatory) and Indonesia into a formal research agreement.

WORK COMPLETED

Acquisition and quality control of existing in situ and satellite data with preliminary assessment of the relevance to regional scale circulation and mixing within the Indonesian Seas has been completed. Development of the preliminary plans for a collaborative oceanographic research program was completed during one month in Indonesia, which included presenting early results, “Increasing the Impact of Wind-Induced Mixing in the Indonesian seas: Upwelling, ENSO, Mindanao and Halmahera Eddies, and Internal Tides“.

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RESULTS

The Seram Sea region has been identified as a key indicator of the processes and timing of the factors that impact the heat and freshwater inventories in the Indonesian Seas, and therefore the linkage by sea-air fluxes to the larger scale climate system. While a map of the Root-Mean-Squares (RMS) of February sea surface temperatures in the Indonesian Seas (Figure 1a) reveals the lowest RMS values in the Seram Sea, of less then 0.35 Celsius, the RMS values in the Seram Sea during August (Figure 1b) are highest within the Indonesian Seas, greater then 0.80 Celsius.

The map of the August average SST for the Indonesian Seas (Figure 2a) shows the overall cool SSTs in the eastern Indonesian Seas during August, but the August anomaly SSTs with the 4 coolest Augusts (1994, 1987, 1982, 2007) minus the 4 warmest Augusts (1998, 2000, 1996, 1988) again identifies the Seram Sea region, with larger then 2 Celsius anomaly, as a key location (Figure 2b). In addition, the ocean temperature profiles of the region reveal the same trends with little temperature variability in February, 1 Celsius or less (Figure 3a) in the western Seram Sea region, but significant temperature variability in August, up to 4 Celsius (Figure 3b) in the western Seram Sea region, when contrasting El Niño versus La Niña years. Therefore variability at both seasonal and interannual timescales is accentuated in the Seram Sea region of the Indonesian Seas identifying it as a key indicator of the processes and timing that impact heat and freshwater inventories and sea-air fluxes.

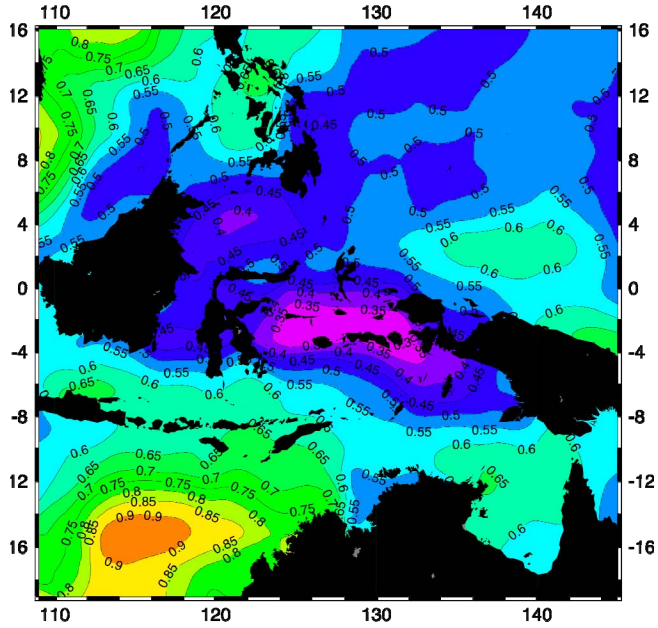

Figure 1a. A map of the Root-Mean-Squares (RMS) of February sea surface temperatures (Celsius) in the Indonesian Seas, calculated from the OI SST dataset. Low RMS, of less then 0.35 Celsius, is revealed in the Seram Sea (magenta region).

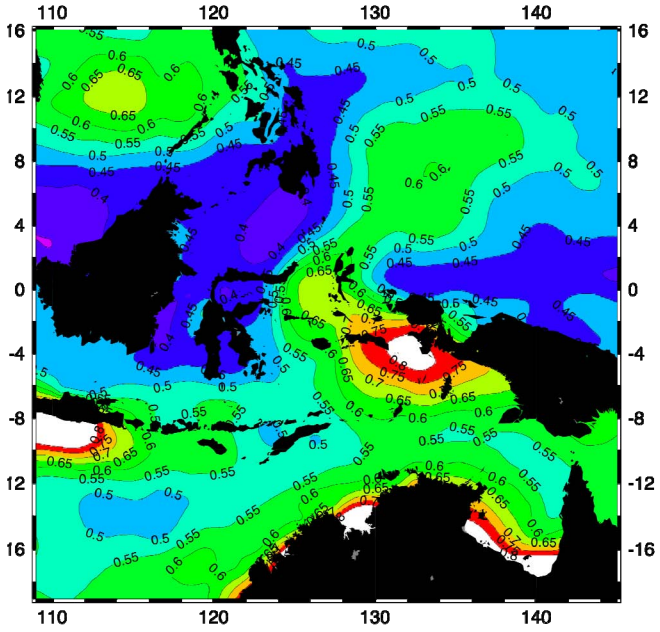

Figure 1b. A map of the Root-Mean-Squares (RMS) of August sea surface temperatures (Celsius) in the Indonesian Seas, calculated from the OI SST dataset. High RMS, greater then 0.80 Celsius, is revealed in the Seram Sea.

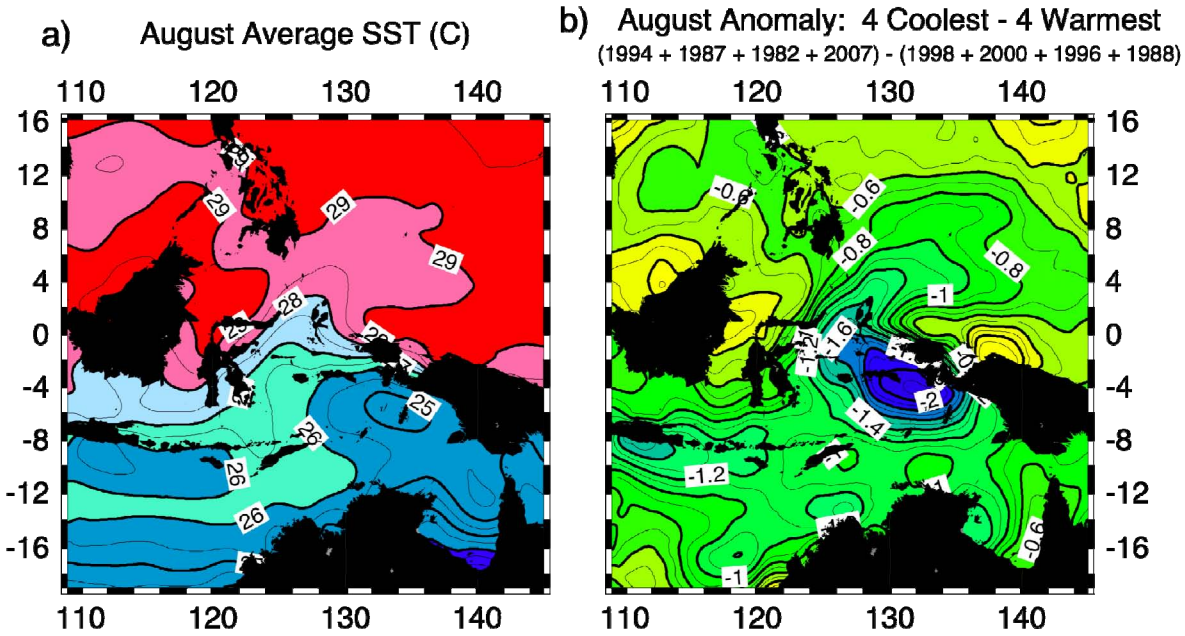

Figure 2. In panel (a) the map of the August average SST (Celsius) for the Indonesian Seas, and in panel (b) the August anomaly SST with the 4 coolest Augusts (1994, 1987, 1982, 2007) minus the 4 warmest Augusts (1998, 2000, 1996, 1988). In panel (b) the largest SST anomaly, larger than 2 Celsius, is revealed in the Seram Sea region.

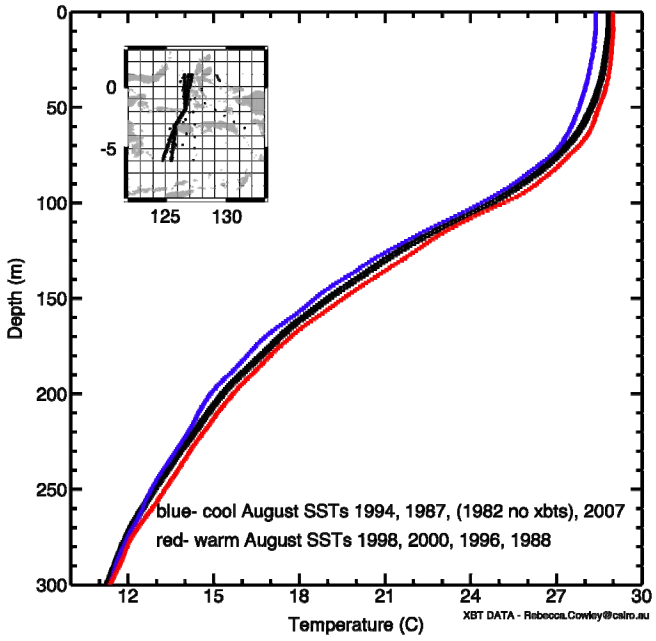

Figure 3a. The February eastern Indonesian seas temperature profiles from XBT data revealing that there is little variability, 1 degree Celsius or less, in the thermocline during February when contrasting El Niño versus La Niña years.

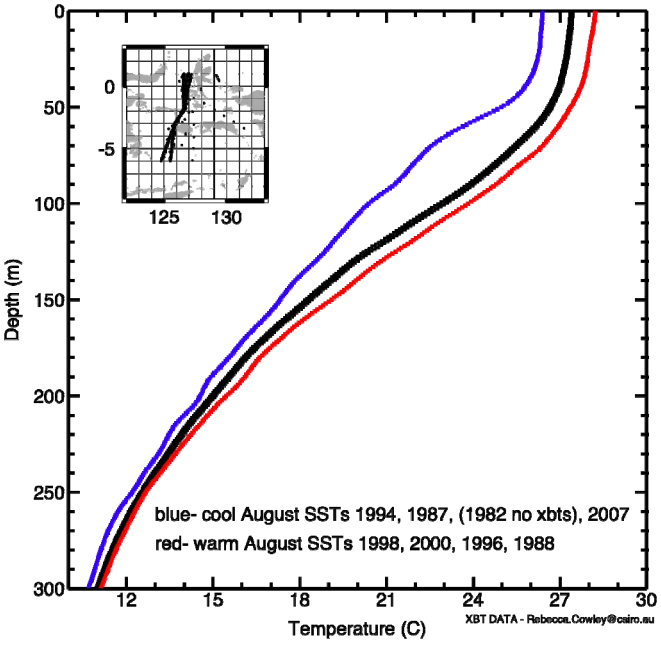

Figure 3b. The August eastern Indonesian seas temperature profiles from XBT data revealing that there is large variability, up to 4 degrees Celsius, in the thermocline during August when contrasting El Niño versus La Niña years.

IMPACT/APPLICATIONS

The transfer of tropical water from the Pacific to the Indian Ocean through the complex archipelago of the Indonesian Seas, the Indonesian Throughflow [ITF] is considered to be a first order factor impacting the heat and freshwater inventories of those oceans, and as such is linked by sea-air fluxes to the larger scale climate system. Increased understanding of the circulation and mixing within the Indonesian Seas associated with topographic configuration, monsoonal driven sea-air flux of momentum and buoyancy, and tides will enable improved estimates of the factors impacting these inventories.

RELATED PROJECTS

None.